

## Fluctuation theorems and 1/f noise from a simple matrix

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### Abstract

© 2016, EDP Sciences, SIF, Springer-Verlag Berlin Heidelberg. Here we present a model for a small system combined with an explicit entropy bath that is comparably small. The dynamics of the model is defined by a simple matrix,  $M$ . Each row of  $M$  corresponds to a macrostate of the system, e.g. net alignment, while the elements in the row represent microstates. The constant number of elements in each row ensures constant entropy, which allows reversible fluctuations, similar to information theory where a constant number of bits allows reversible computations. Many elements in  $M$  come from the microstates of the system, but many others come from the bath. Bypassing the bath states yields fluctuations that exhibit standard white noise; whereas with bath states the power spectral density varies as  $S(f) \propto 1/f$  over a wide range of frequencies,  $f$ . Thus, the explicit entropy bath is the mechanism of 1/f noise in this model. Both forms of the model match Crooks' fluctuation theorem exactly, indicating that the theorem applies not only to infinite reservoirs, but also to finite-sized baths. The model is used to analyze measurements of 1/f-like noise from a sub-micron tunnel junction.

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### Keywords

Statistical and Nonlinear Physics